



**Final**  
**Interconnection Facilities Study Report**

**Request # GI-2006-1d**

Spindle Hill Energy LLC Facility Study

July 2006

Xcel Energy Services, Inc.  
Transmission Planning – Denver, CO

## I. Executive Summary

This Interconnection Facilities Study Report summarizes the analysis performed by Public Service Company of Colorado (PSCo) to specify and estimate the cost of the equipment, engineering, procurement, and construction needed to interconnect 269 MW of generation (net summer capability 269 MW, net winter capability 314 MW) at a new PSCo's Spindle Switching Station in the town of Frederick, Colorado. The switching station would tap PSCo's Ft. St. Vrain to Valmont 230 kV transmission. The requested commercial in-service date of the generation facilities is May 1, 2007. The study results show that it may be feasible to implement the upgrades required for interconnection to facilitate the commercial in-service date of May 1, 2007.

The total estimated cost for the facilities required for interconnection is approximately **\$4.02 million**<sup>1</sup> including:

- \$0.46 million for Customer-funded Interconnection Facilities
- \$3.56 million for PSCo Network Upgrades for Interconnection

The estimated time required to engineer, permit and construct the facilities described above is at least 21 months. However, the Customer has taken responsibility for some preliminary tasks associated with the interconnection. Based on these actions, it is anticipated the in-service date of the interconnection can be accelerated.

The project was studied as a Network Resource per the System Impact Study Agreement. The Network Upgrades recommended for firm delivery of the generation were identified in the System Impact Study, and consist of upgrading the 230 kV double-circuit Ft. St. Vrain to Valmont/Leggett transmission line to 525 MVA continuous rating and replacing six 230 kV breakers at Ft. St. Vrain. The System Impact Study Report estimated the cost of these additional upgrades associated with Delivery to be \$2.75 million<sup>2</sup>. The estimated time frame to implement the facilities required for delivery is at least 12 months. Therefore, it is not feasible to implement the facilities required to accommodate delivery of the generation to PSCo customers on a firm basis by the proposed in-service date and some re-dispatch of generation may be required under certain operating conditions.

A simple diagram for Network Upgrades for Delivery and the regional transmission system for this request is depicted in Figure 1, and a simple one-line diagram of the proposed interconnection facilities shown in Figure 2.

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<sup>1</sup> Appropriation estimate considered to have an accuracy of +/- 20%.

<sup>2</sup> Scoping estimate considered to have an accuracy of +/- 30%.

Figure 1: PSCo's Regional 230 kV Transmission System One-Line Diagram

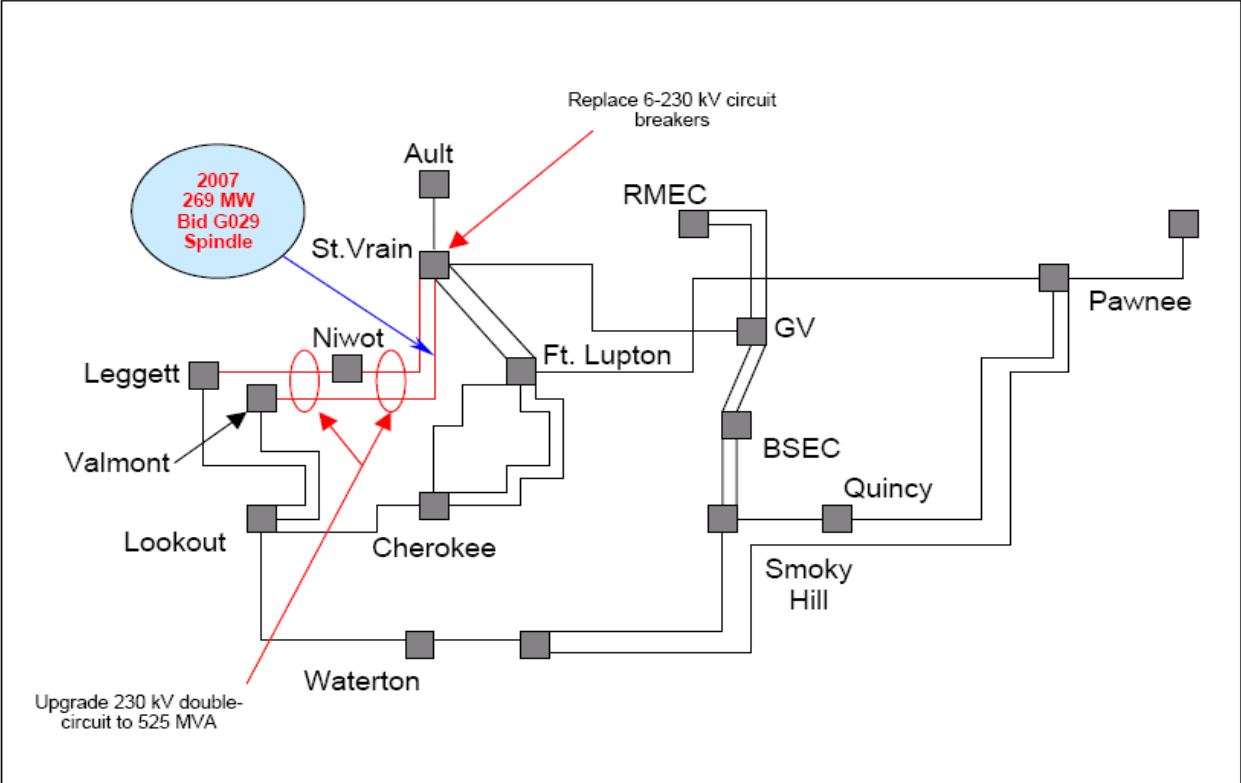
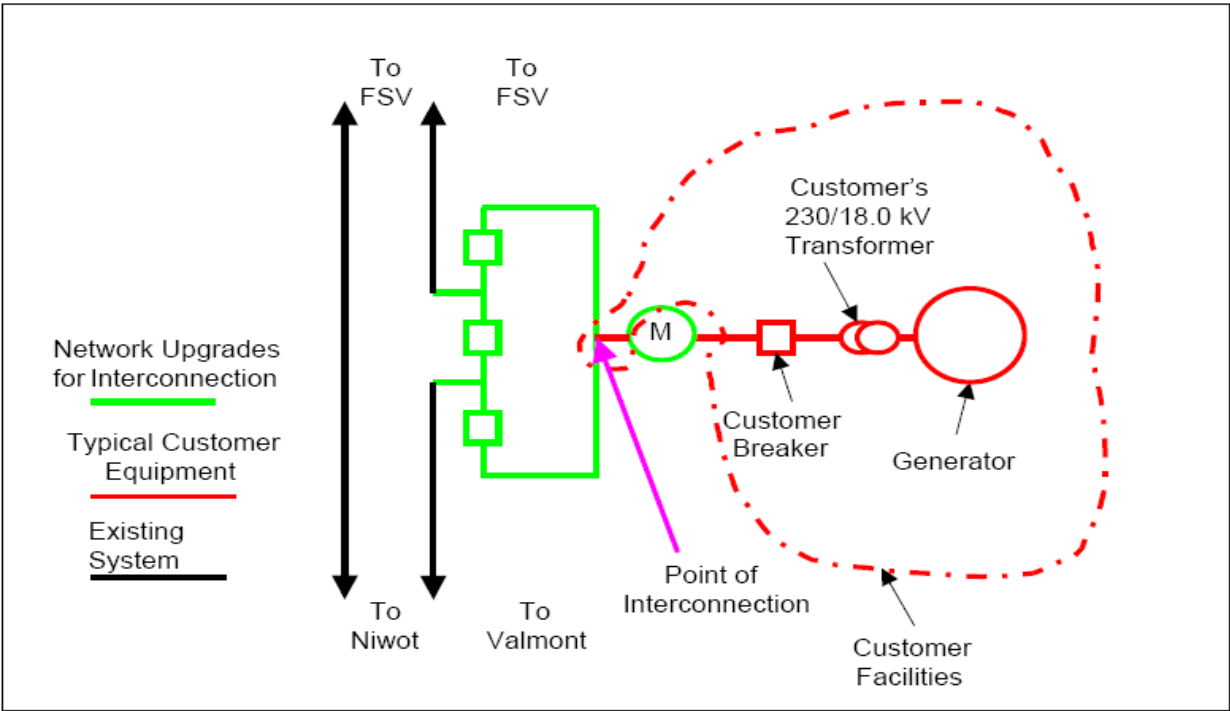


Figure 2: Interconnection One-Line Diagram



## II. Introduction

On February 10, 2006 Xcel Energy Transmission received a request to conduct a System Impact study that would evaluate the integration of a “cluster” of potential generation resources. The Spindle Project was one of the resources considered in the “cluster-study”. The System Impact Study report was issued and posted on the Rocky Mountain Area OASIS (RMAO) web site on May 25, 2006 and June 21, 2006 at which date the Spindle Project was identified as a project that would proceed with the Facility Study process. An Interconnection Facilities Study Agreement was executed with the Customer on July 06, 2006.

## III. General Interconnection Facilities Description

### 1. Project Purpose & Scope

The purpose of this project is to interconnect a gas-powered generation facility of 269 MW into a new PSCo Spindle 230 kV Switching Station. The Spindle Switching Station will be a 3-breaker ring bus that will tap the Ft. St. Vrain to Valmont 230 kV transmission line. The Customer intends to build a 1-mile 230 kV transmission line from their site to the switching station. The generation project will be located east of the Spindle Switching Station. Figure 4 shows a preliminary one-line diagram of the interconnection to Spindle Switching Station. Figure 5 shows a general arrangement layout drawing.

To accommodate full delivery of the 269 MW generation, the 230 kV double circuit transmission from Ft. St. Vrain to Valmont/Leggett must be upgraded to 525 MVA continuous rating and six 230 kV breakers must be replaced at Ft. St. Vrain.

### 2. Other Considerations

The Customer has taken responsibility for, and completed many of the Siting, Permitting and Land Acquisition tasks and a few of the Transmission Provider's preliminary activities under the Engineering & Procurement Agreement (E&P). The expected project schedule may be accelerated based on these actions.

### 3. Interconnection & Network Upgrades for Interconnection

Requirements for interconnection can be found in the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW – Version 2.0, last revised in January 2004. Xcel Energy requires the Interconnection Customer to construct the Interconnection Facilities in compliance with this document. This document describes the technical and protection requirements for connecting new generation to the Xcel Energy operating company transmission system and also

includes commissioning, operation, and maintenance guidelines. Xcel Energy also requires that the Interconnection Customer be in compliance with all applicable criteria, guidelines, standards, requirements, regulations, and procedures issues by the North American Electric Reliability Council, Western Electricity Coordinating Council, and Federal Energy Regulatory Commission or their successor organizations.

a) Removals and Relocations

The Spindle switching station is a new facility. No removals are required. Primary relay channel communication equipment will be relocated from Ft. St. Vrain to Spindle for the Spindle to Valmont 230 kV transmission line.

b) Fault Current

The worst-case 3-phase short circuit fault current is approximately 11kA at the approximate location of Spindle substation. These values have been modeled prior to the new generation being installed.

c) Electrical Installations

The Spindle Substation will be configured as a three-breaker 230kV ring bus sectionalizing the existing 230 kV Ft. St. Vrain to Valmont 230 kV transmission line.

The interconnection guidelines mentioned above require the Customer to install 230 kV circuit breaker protection on the Customer's end of the 1-mile transmission line to isolate PSCo equipment from the generating facility.

The step-up transformer at the customer facility shall be designed to meet the interconnection guidelines mentioned above. The configuration shall be grounded wye on the 230kV primary side and delta on the 18.0kV secondary side. This requirement is needed to meet PSCo's requirements for an effectively grounded system.

d) AC & DC Systems

New AC and DC panels will be supplied in the Electrical Enclosure Equipment (EEE).

e) Control Building (EEE)

A medium sized EEE will be installed, complete with battery, charger, AC and DC panels, lighting and HVAC system.

f) Grounding

All standard grounding practices in the substation will be observed. All equipment and associated structures will be connected to the ground mat.

g) Lighting Protection

Arresters will not be installed in Spindle Switching Station. Static masts and static wire will be installed per the design.

#### **4. Civil Features**

##### **a) Grading and Fencing**

Grading will be created for siting and permitting.

##### **b) Foundation and Structural**

All foundations and structures are new. The following is a list of equipment that will be required to accommodate the new 230 kV Switching Station:

- Three (3) dead-end structures
- Three (3) breaker foundations
- Twelve (12) 230 kV gang switch foundations
- Three (3) metering instrument foundations
- One (1) EEE foundation

##### **c) Removals and Relocations:**

No foundations are required to be removed or relocated.

#### **5. Protection and Control Features**

##### **a) Electrical Installations**

A new relay panel will be installed in the control building at Spindle Switching Station. Line protection will consist of a SEL 321 (Pkg-P), SEL 311C (Pkg-S) and SEL 501 (for breaker failure) using a 4-wire analog line for communication for the primary relay (SEL 321). The backup relay, SEL 311C, will have no communication. High speed auto re-closing will be implemented. Transducers will be installed on the new relay panel for SCADA telemetry. A new RTU/LCU will be installed and utilized for SCADA.

#### **6. Disturbance Monitoring Device**

A disturbance monitoring device is not required at Spindle Switching Station.

#### **7. Communications**

An RTU at Spindle Switching Station will handle the SCADA information for the new transmission line and generating facility. An SEL 2030 will be installed for relay communications and other functions as required. A phone line will also be added for the SEL 2030 communication.

#### **8. Outages**

The existing Ft. St. Vrain to Valmont 230 kV line will be out of service during the cutover period for the Spindle Switching Station. This cutover period shall be minimized as much as possible.

## **9. Project and Operating Concerns**

There appears to be no significant Project or Operating Concerns at this time.

## **10. Transmission Line Tap Structures and Tap**

The existing PSCo Ft. St. Vrain to Valmont 230 kV transmission would be tapped to provide interconnection to the Spindle Project. The following is a list of equipment that will be required:

- Two (2) concrete caisson foundations
- One (1) double circuit dead end steel pole
- One (1) double circuit tangent steel pole
- Install approximately 2,500 ft of 1033.5 kcmil 45/7 ACSR Ortolan conductor

## **11. Assumptions for Spindle Gas Generator Facility**

Customer will engineer, procure, and construct all equipment up to the PSCo's Spindle 230 kV dead-end structure. This includes transmission line relay equipment at Customer's site.

The Customer will arrange for station service power through the local utility/service provider, as Customer's site is not in PSCo service territory.

Customer has proposed to construct the transmission line with fiber optic ground wire built into the static wire for relay communication.

PSCo needs approximately 4-6 weeks to test. Much of the testing can be performed in parallel with the construction schedule.

## **IV. Costs Estimates and Assumptions:**

### **A. Interconnection**

Table 1 describes the costs assumed for work to be performed by PSCo, and funded by the Customer, for the dedicated "sole-use" interconnection facilities installed between the 230 kV Point of Interconnection located at Spindle Switching Station, and the Customer Generation Facility. The estimated total cost for the PSCo Interconnection Facilities and Network Upgrades to provide an Interconnection for the Customer requested generation is:

- **\$0.46 million for Customer Interconnection Facilities at Spindle Switching Station (Customer funded).**
- **\$3.56 million for PSCo Network Upgrades for Interconnection at Spindle Switching Station (PSCo funded).**
- **Total Estimated cost of Interconnection = \$4.02 million**

The estimated costs shown above are “appropriation estimates” with an accuracy of ± 20%. These estimates are in 2006 dollars, do not include escalation, and are based upon typical construction costs for previously performed similar construction. These estimates do not include any costs for any Customer-owned, supplied, and installed equipment and associated design and engineering for the Customer’s facilities.

**Table 1: PSCo Transmission Interconnection Facilities (Customer funded):**

Element	Description	Cost (\$Million)
<b>New PSCo Customer Tap Switchyard</b>	Interconnect 230 kV line from Customer’s Facility to a new 230 kV PSCo switchyard. The new equipment required includes: <ul style="list-style-type: none"> <li>• 230 kV bidirectional revenue metering</li> <li>• Required steel supporting structures</li> <li>• Associated metering control and relaying equipment</li> </ul>	<b>\$0.46</b>
<b>Time Frame</b>	<b>Months - Substation</b>	<b>6 months</b>
<b>Total</b>	<b>Customer Interconnection Facilities</b>	<b>\$0.46</b>

Table 2 describes the estimated costs of PSCo Transmission Network Upgrades associated with the Spindle Project Interconnection.

**Table 2: PSCo Transmission Network Upgrades Required for Interconnection:**

Element	Description	Cost (\$Million)
<b>New PSCo Spindle Switching Station</b>	Construct Spindle 230 kV substation to interconnect the facility. The new equipment required includes: <ul style="list-style-type: none"> <li>• Three (3) 230 kV 3000 amp 40 kA circuit breakers</li> <li>• Site development and land</li> <li>• Control building</li> </ul>	<b>\$3.02</b>
	<b>Transmission Line tap structures and tap</b>	<b>\$0.17</b>
	<b>Siting &amp; Land Rights</b>	<b>\$0.34</b>
<b>Ft. St. Vrain Station</b>	Replace transmission line relaying communication	<b>\$0.03</b>
<b>Total Cost</b>	<b>Estimated Costs for Network Upgrades for Interconnection</b>	<b>\$3.56</b>
<b>Time Frame</b>	<b>Months - Substation</b>	<b>21 months</b>



## **B. Major Assumptions related to Table 1, Table 2 and the attached schedule**

- The interconnection estimated costs provided are “Appropriation Estimates” with an accuracy of  $\pm 20\%$ .
- All applicable overheads are included. AFUDC has been included with the PSCo Network Upgrades and removed from the Customer Interconnection Facilities.
- There is no contingency added to the estimates.
- Estimates have not been escalated. All estimates are in 2006 dollars.
- Generation is not in PSCo’s retail service territory; therefore no costs for retail load metering are included in these estimates.
- PSCo (or its contractor) crews will perform all construction and wiring associated with PSCo-owned and maintained equipment.
- All required transmission outages necessary to support construction will be obtained as needed.
- Land necessary for the new 230kV switchyard will be available within close proximity to the transmission line to be sectionalized.

## **V. Engineering, Procurement & Construction Schedule**

The following schedule, shown in Figure 3, identifies milestones needed to complete the interconnection of the proposed 269 MW gas generation facility. This schedule identifies project milestones for three separate phases of work needed to complete the proposed interconnection: Siting, Permitting & Land Acquisition, Substation Design & Construction and Transmission Line Design & Construction. The total estimated duration to complete all of the required activities and tasks is 21 months after Customer requirements in the Appendix B of the LGIA are satisfactory to PSCo. However, this project is estimated to be in the 13<sup>th</sup> month of the 21 month schedule, since the Customer has taken responsibility for and completed the majority of the Siting, Permitting and Land Acquisition tasks required and the Customer has entered into an E&P Agreement with the Transmission Provider and funded the preliminary activities and tasks required to advance the project prior to receiving written authorization to proceed with design and procurement.

**Figure 3: Engineering, Procurement & Construction Schedule**

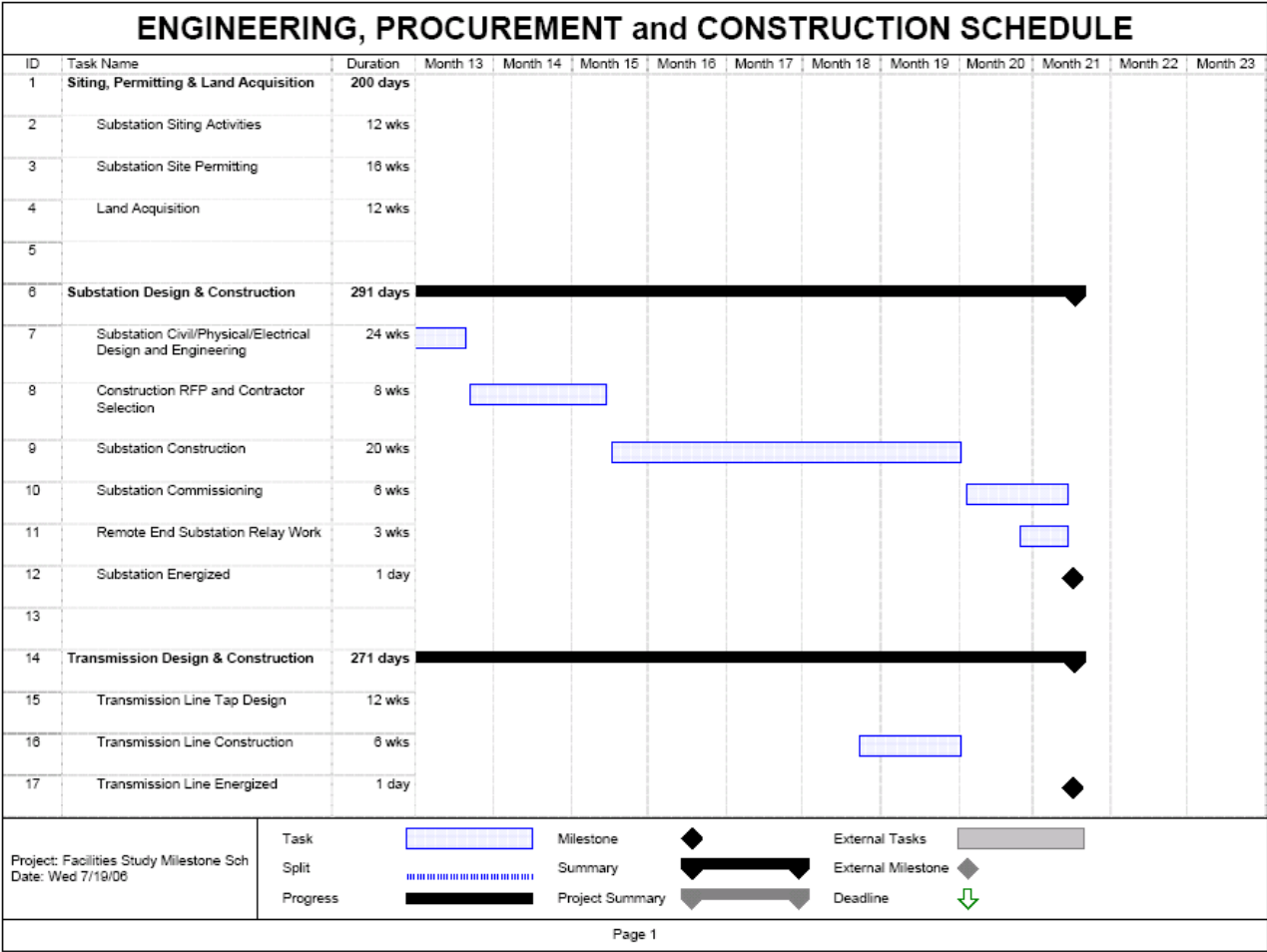
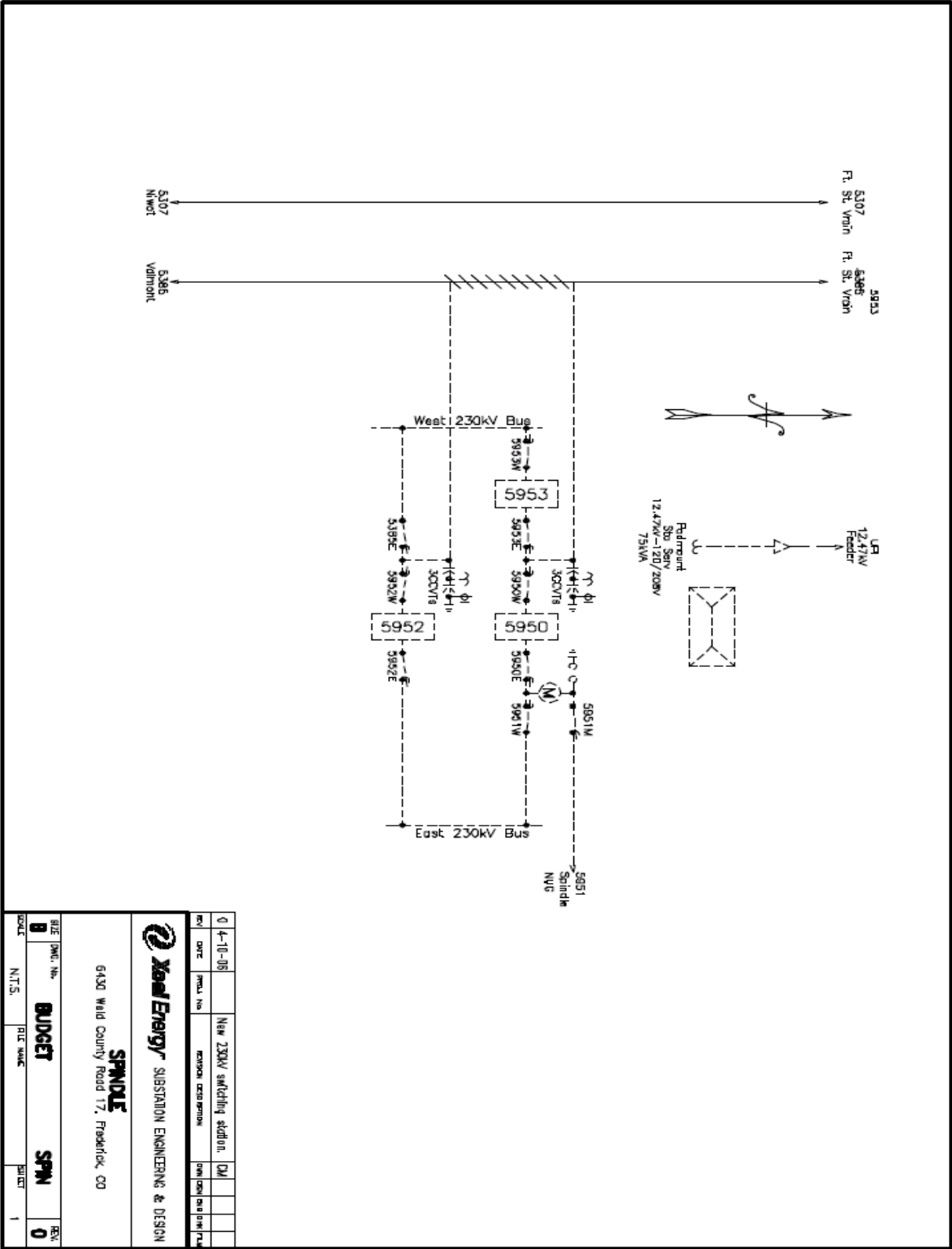


Figure 4: PSCo's Spindle Switching Station: Proposed One-Line Diagram



REV	DATE	DESCRIPTION	BY	CHKD	DATE
0	4-10-08	New 230kV switching station.			

FILE NO.	PROJECT NO.	DATE
8		

REV	DATE	DESCRIPTION
0		

REV	DATE	DESCRIPTION
0		

**SPINDLE**  
 6430 Wild County Road 17, Frederick, CO

**Xcel Energy**  
 SUBSTATION ENGINEERING & DESIGN

DATE: 11-13-08  
 DRAWN BY: [Name]  
 CHECKED BY: [Name]

